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Insecta, Hymenoptera, Bethylidae: range extension and filling gaps in Central African Republic

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Abstract: Bethylidae are cosmopolitan wasps, with about 100 valid genera and about 2,600 valid species around the world. This study aimed to determine the genera of Bethylidae occurring in Central African Republic. The specimens were collected at three sites using three collecting methods. A total of 1,924 specimens were obtained and 18 genera recorded: *Apenesia*, *Cephalonomia*, *Dissomphalus*, *Epyris*, *Goniozus*, *Holepyris*, *Laelius*, *Pararhabdepyris*, *Parascleroderma*, *Plastanoxus*, *Pristocera*, *Protisobrachium*, *Pseudisobrachium*, *Sulcomesitius*, *Trachepyris*, *Trichiscus*, *Tuberepyris* and *Zimankos*. All of these genera are recorded for the first time from this country.

Key words: Afrotropical region, Chrysidoidea, parasitoid wasp, biodiversity

INTRODUCTION

Bethylidae are widely distributed throughout the world, but the majority of species occur in tropical regions (Azevedo 1999). The family comprises about 100 genera and about 2,600 described species, with 37 genera recorded from the Afrotropical region. This study aimed to determine the genera of Bethylidae occurring in Central African Republic based on the first sampling in this country.

MATERIALS AND METHODS

Surveyed area

The Dzanga-Sangha protected area lies north of the equator and is located in the southwest triangle of the Central African Republic (Sangha-Mbaéré Prefecture), which is sandwiched between Cameroon and the Republic of Congo. Together with Lobéké National Park (Cameroun) and Nouabalé Ndoki National Park (Congo) this protected area forms part of the Trinational Sangha (TNS) complex. The Dzanga-Sangha protected area includes the Dzanga sector (495 km²) and the Ndoki sector (725 km²), which together form the Dzanga-Ndoki National Park, and the Dzanga-Sangha Dense Forest Special Reserve (3359 km²), a multiple use zone where logging, traditional hunting, safari hunting and extraction of plants are still allowed under controlled conditions.

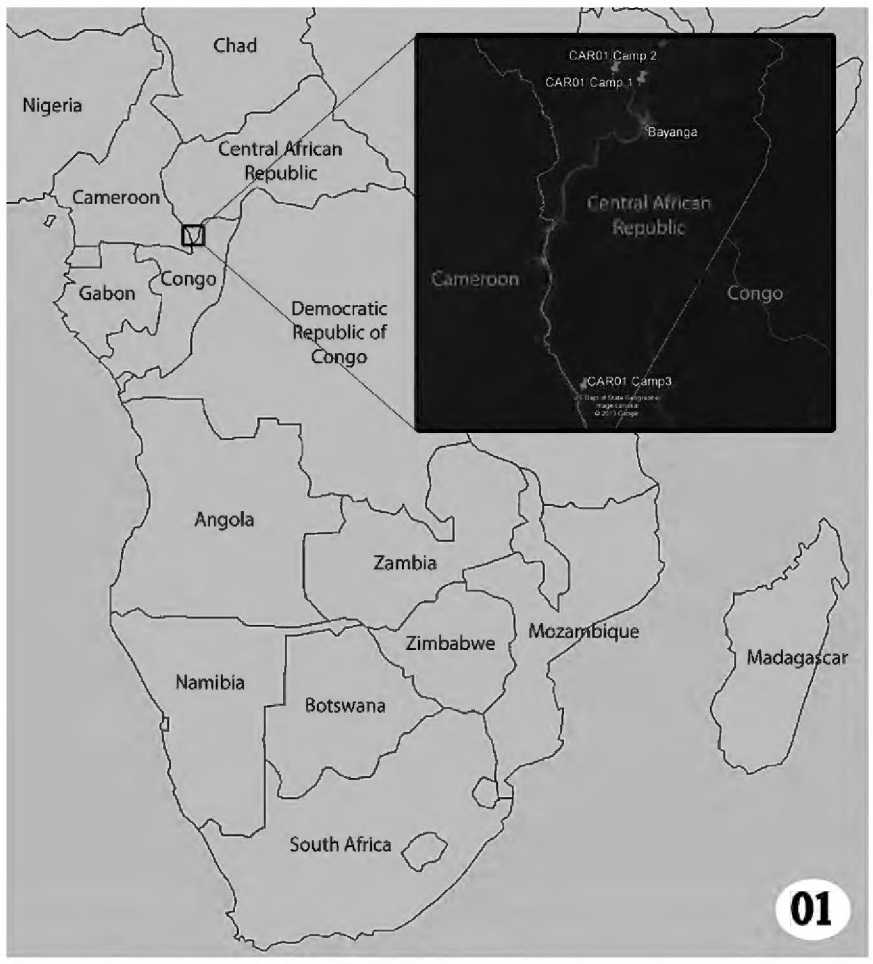
Annual rainfall is about 1,500 mm, with average temperatures ranging between 25° and 29° C. There are two peaks to the rainy season with highest precipitation occurring during the "long rains" from September to November and a second peak during the "short rains" in May and June (Carroll 1997). The ecoregion is a part of the Guineo-Congolian lowland rain forest within the Guineo-Congolian regional centre of endemism (White 1983), characterized by the following species: *Entandrophragma congoense* (Meliaceae); *Pentaclethra eetveldeana* (Mimoseae); *Pericopsis elata* (Fabaceae); and *Gilbertiodendron dewevrei* (Fabaceae). The canopy can reach a height of 60 m. The understory is composed of shrubs, lianas and herbs. Harris (2002) recorded 1090 species of vascular plants in the reserve.

Sampling sites

Three separate sites within the forest were sampled (named Camps 1–3), relatively spatially distributed as follows: Camp 2 was situated 6.4 km WNW of Camp 1; Camp 3 was situated 75 km south of the first two camps (Figure 1).

CAMP 1 (Figure 2) was situated at a marsh clearing, Mabéa Bai, in lowland rainforest 21.4 km 53° northeast of Bayanga, 03°02.01′ N, 016°24.57′ E, 510 m, in the Dzanga-Ndoki National Park and was sampled from the

1–8 May 2001. The marsh clearing forms an opening in the dense lowland rainforest and has small streams running through it. Marsh clearings are associated with red, clay-rich dolerite derived soil patches that form pockets within the more widely distributed white sandy granite derived soils that generally form the substrate of the closed forest. The vegetation in the Bai is dominated by herbaceous plants including abundant sedges (Cyperaceae) and grasses (Graminae). Nine Malaise traps were erected along the forest margin on the borders of the clearing and two Malaise traps were situated within the forest along a stream clearing running into the Mabéa Bai (hereafter referred to as Bai). Characteristic trees of the forest margin include *Lophira alata* and *Berlinia grandiflora*. On one side of the Bai the closed forest was dominated by a homogenous patch of *Gilbertiodendron dewevrei*. Twenty-five yellow pan trap stations were laid out in a linear transect across the Bai at 5 m intervals, the transect encompassing the main stream running through the centre of the Bai. Sweeping was conducted within the Bai sampling the herbaceous vegetation, along the forest margin sampling the low canopy, and within the adjacent forest in more open areas along streams or elephant paths sampling the undergrowth and low canopy.



Figures1–5. 1: Sampling sites; **2**: Camp site 1; **3**: Camp site 2; **4**: Camp Site 3; **5**: Habitus of *Pristocera*.

CAMP 2 (Figure 3) was situated in lowland rainforest on the banks of the Sangha River in the Dzanga-Sangha Dense Forest Special Reserve, 12.7 km 326° northwest of Bayanga, 03°00.27′ N, 016°11.55′ E, 420 m, and was sampled from 10–17 May 2001. The river is about 500 m wide at this point and ranges from a depth of 20 cm at the end of the dry season (around March) to as much as 5 m during the height of the rainy season in September and October when the forests adjacent to the banks are flooded. This seasonally flooded forest has a complex architecture with 15–25 m trees forming a canopy with occasional emergent trees to 40 m with gaps less common. The understory consists of small trees (5–10 m) with herbs and lianas common, whereas shrubs are almost absent (Harris 2002). Seven Malaise traps were sited in this seasonally flooded forest on the banks of the Sangha River within the flood plain where the understory comprised large herbs (Marantaceae and Zingiberaceae). Four Malaise traps were sited away from the river at higher elevation in mixed species *terra firma* forest that is not seasonally flooded, mostly in tree-fall clearings, containing herbaceous growth. Sweeping was conducted in both forest types sampling undergrowth and low canopy. 25 yellow pan trap stations were laid out in a linear transect in the seasonally flooded forest on the banks of the Sangha River at 5 meter intervals.

CAMP 3 (Figure 4) was situated in lowland rainforest about 1 km from the banks of the Sangha River in the Dzanga-Ndoki National Park, 38.6 km 173° south of Lidjombo, 02°21.60′ N, 016°09.20′ E, 350 m, and was sampled from 20–27 May 2001. Six Malaise traps were sited within the seasonally inundated riparian forest (see above for species composition). Five Malaise traps were erected in mixed species *terra firma* forest along an elephant path above the flood plain. Twenty-five yellow pan trap stations were laid out at 5 m intervals in a linear transect commencing in the seasonally inundated forest and extending along an elephant path into forest above the flood plain. Sweeping was conducted in both areas sampling undergrowth and low canopy within less densely vegetated areas along streams or elephant paths.

Sampling methods and efforts

The Malaise traps were constructed to the specifications of the Townes design (Townes 1972), and made with a fine-meshed netting (grid size of 0.2 mm), with black walls and a white roof. Eleven Malaise traps were run for 7 days at each camp and each trap serviced every day (= 231 Malaise trap samples). Twenty-five yellow pan traps (YPT) (yellow plastic bowl of 165 mm in diameter × 40 mm deep) were placed on the forest floor along a linear transect and run for 7 days at each camp (= 75 YPT samples). One hundred samples comprising 20 sweeps each were carried out at each camp (= 2000 sweeps per camp), resulting in a total of 300 sweep samples (= 6000 sweeps). The sweep net used for sampling was based on the design of Noyes (1982), with an opening area of ca. 1,300 cm², and a collecting bag constructed from fine-meshed netting with a grid size of 0.2 mm. These quantified, replicated sampling protocols were supplemented with *ad hoc* hand collecting at each camp.

The studied material is deposited at Iziko South African Museum (SAMC) in Cape Town, South Africa.

The identification of the genera was based on the keys by Terayama (2003), Lanes and Azevedo (2008), and Argaman (2003). Many years will be necessary to cover the identification of all this material at species level. Most of the material corresponds to undescribed species, restricting the present study to a generic level assessment.

RESULTS AND DISCUSSION

A total of 1,924 specimens were obtained and 18 genera were recognized representing all five extant subfamilies (Table 1).

All these 18 genera are recorded for the first time from Central African Republic, except *Trichiscus* Benoît, which were recorded recently by Azevedo (2014). *Apenesia* Westwood, *Cephalonomia* Westwood, *Dissomphalus* Ashmead, *Epyris* Westwood, *Goniozus* Förster, *Holepyris* Kieffer, *Laelius* Ashmead, *Parascleroderma* Kieffer, *Plastanoxus* Kieffer, *Pseudisobrachium* Kieffer are cosmopolitan. The occurrence of these genera in Central African Republic emphasizes their wide distribution.

Trachepyris Kieffer, *Sulcomesitius* Móczár, *Zimankos* Argaman and *Pristocera* Klug (Figure 5) are confined to the Old World. All of the above mentioned genera are already recorded from Sub-Saharan Africa (see Gordh and Móczár 1990).

Protisobrachium Benoît (two species, D.R. Congo and

Table 1. Number (#) and frequency (%) of specimens by genus examined during this study.

Subfamily	Genus	#	%
Bethylinae	*Goniozus* Förster	56	2.9
Epyrinae	*Epyris* Westwood, 1832	454	23.6
	Holepyris Kieffer, 1905	343	17.8
	Laelius Ashmead, 1893	01	0.1
	Trachepyris Kieffer, 1905	04	0.2
Mesitiinae	*Sulcomesitius* Móczár 1970	03	0.2
	Zimankos Argaman, 2003	42	2.2
Pristocerinae	*Apenesia* Westwood, 1874	121	6.3
	Dissomphalus Ashmead, 1893	457	23.7
	Parascleroderma Kieffer, 1904	01	0.1
	Pristocera Klug, 1808	108	5.6
	Protisobrachium Benoit, 1957	32	1.7
	Pseudisobrachium Kieffer, 1904	168	8.7
	Trichiscus Benoit, 1957	119	6.2
Scleroderminae	*Cephalonomia* Westwood, 1833	08	0.4
	Pararhabdepyris Gorbatovsky, 1995	01	0.1
	Plastanoxus Kieffer, 1905	04	0.2
	Tuberepyris Lanes & Azevedo, 2008	02	0.1
	TOTAL	1924	100

one species, Thailand) (Terayama 1995), and *Tuberepyris* Lanes & Azevedo (one species, Tanzania) (Lanes and Azevedo 2008) are very small genera. The Central African Republic records for these genera expand their restricted distribution and since these specimens represent undescribed species they are important from a taxonomic perspective allowing for a re-assessment of generic delimitation.

Pararhabdepyris Gorbatovsky is recorded for the first time from the Afrotropical region. This genus has only three species from Australia (Australasian region), Thailand (Oriental region) and Far Eastern Russia (Palaearctic region) (Azevedo and Barbosa 2010). Thus these three species were previously confined to the extreme eastern section of the Old World, which represents a large gap in relation to the single specimen of *Pararhabdepyris* found in Central African Republic. This suggests that the genus is present in a much larger area than the current records indicate.

The fact that all 18 genera of Bethylidae were found in one project, and recorded for the first time from this country demonstrates the large gap of knowledge of flat wasps in Africa and the necessity of more sampling. As pointed out by Azevedo (2006) for the Australian fauna and Mugrabi and Azevedo (2010) for the Malagasy fauna, this conclusion can certainly be extended to other areas of the world.

Dissomphalus, *Holepyris*, and *Epyris* were found in large series of specimens, representing about 65% of all the material reported in this work. Out of this total, almost 24% of the specimens belong to *Dissomphalus*, which is the most abundant genus in our samples. This dominance is explained by the fact that the sampling localities were all situated in lowland rainforest, which receives high rainfall and, as proposed by Azevedo and Helmer (1999) and Mugrabi et al. (2008), this genus is best represented in humid environments.

Finally, considering the relatively limited sampling effort (see section Sampling methods and efforts) the Central African Republic bethylid fauna is rich in terms of genera diversity. More expeditions are required in order to explore a wider habitat range and deployment of a greater diversity of collection methods. This lack of base-line species and generic richness data can be extended to all of Africa, the poorest sampled continent for the bethylids.

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